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SYNOVITIS ASSOCIATED WITH QUADRICEPS WEAKNESS IN PERSONS WITH OSTEOARTHRITIS OF THE KNEE: RESULTS FROM THE AM-OA COHORT

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Purpose: To explore associations between tissue abnormalities (bone marrow lesions, effusion, synovitis, cartilage loss and osteophytes) visualised by MRI, with both biomechanical impairments (proprioceptive inaccuracy, laxity, quadriceps and hamstrings weakness) and clinical symptoms (pain, stiffness, activity limitations and crepitus) in a cohort of patients with knee osteoarthritis (OA).
Methods: Cross-sectional study in 105 patients with knee OA from the Amsterdam Osteoarthritis cohort. Multivariable regression analyses were used to explore associations between MRI features in each compartment with OA symptoms.
Results: Associations were found between presence of synovitis with quadriceps weakness (p=.004) and between severity of cartilage loss in the patellafemoral compartment with quadriceps weakness (p=.035). No associations were found for proprioceptive inaccuracy, laxity and hamstrings weakness. Medial tibiofemoral cartilage loss was the only MRI feature associated with pain and activity limitations. In contrary, all MRI features, except for synovitis, were found to be associated with the presence of crepitus.
Conclusions: As we far as we know, this is the first study to find a significant association between synovitis and quadriceps weakness. This relationship was independent of pain severity. It may imply that strategies that decrease inflammation might be valuable to prevent clinical deterioration in OA patients. Since inflammation had not been identified by physical examination in most cases with MRI-assessed synovitis, MRI can play an important role in clinical assessment of knee OA patients.

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METABOLIC DISTURBANCES IDENTIFIED BY SPECT-CT IN PATIENTS WITH A CLINICAL DIAGNOSIS OF SACROILIAC JOINT INCOMPETENCE

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The sacroiliac joint (SIJ) as a source of lower back pain is a controversial issue. There is literature on its role as part of the pelvic girdle pain syndrome in the peri-partum period. In the absence of an adequate imaging test, firm clinical criteria for the diagnosis have been established. There is little literature on trauma as a cause of SIJ dysfunction. We examined the role of hybrid scintigraphic imaging in a population with SIJ dysfunction on the basis of both trauma and peri-partum lower back pain.
Methods. Patients who fulfilled the published criteria for pelvic girdle syndrome either on the basis of peripartum SIJ dysfunction or trauma were entered into the trial prospectively. These patients were imaged with standard bone scintigraphy with the addition of hybrid imaging with SPECT/ CT. Studies were blindly reported together with a control group without lower back pain and a second group with non-specific low back pain.
Results. The study group comprised 100 patients (72F, 28M) who fulfilled the criteria for SIJ dysfunction. Of these 52% gave a history of trauma and the remainder were patients with peri-partum pain. Average age was 43 years and average length of history was > 2 years. The major finding was of increased uptake in the upper SIJ and posterior soft-tissues/ ligaments. Hybrid imaging had a sensitivity of 95% and specificity of 99%. Positive predictive value was 99% and negative predictive value 94%. Reproducibility of the test is good with kappa values of 0.85.
Conclusion. Hybrid imaging with SPECT/ CT reproducibly demonstrates metabolic alterations around the SIJ in patients with SIJ dysfunction, which we have termed SIJ incompetence. The condition is more common than previously recognized and frequently occurs after trauma, which has not been reported previously.

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EXTENT OF TIBIOFEMORAL OSTEOARTHRITIS PRIOR TO KNEE ARTHROPLASTY: MULTICENTER DATA FROM THE OSTEOARTHRITIS INITIATIVE

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Purpose: Knee arthroplasty is traditionally recommended for persons with knee joint failure due to osteoarthritis (OA). Systematically obtained evidence describing the extent of tibiofemoral arthritis in patients prior to knee arthroplasty is lacking. Our purpose was to use data from the multicenter Osteoarthritis Initiative (OAI) to quantify diagnoses of the extent and type of tibiofemoral OA in persons who underwent knee arthroplasty less than 1 year prior to a standardized knee radiograph.
Methods: *All persons in the OAI had yearly 20-degree fixed flexion standing knee radiographs over a 3-year period. Z-tests were used to determine if the proportion of patients with Kellgren-Lawrence grades* ≥3 differed from literature-based estimates.
Results: 116 persons from communities in 4 US locations underwent knee arthroplasty during the three-year follow-up period. The proportion of persons with KL grade ≥3 was 0.81 (95% CI, 0.73, 0.89) and was significantly lower than the 0.95 estimated population proportion (p< 0.001). A total of 82 of 97 pre-surgical knees (85%) had at least one tibiofemoral joint compartment that had no joint space narrowing.
Conclusions: Variation in the extent of tibiofemoral OA in patients preparing for joint arthroplasty is greater than previously described. The data suggest that approximately 1 in 6 patients undergo knee arthroplasty with a Kellgren Lawrence grade of 2 or less. In addition, the great majority (85%) patients who undergo knee arthroplasty have definite tibiofemoral joint space narrowing in only one compartment.These data strongly suggest that a substantial number of patients are undergoing knee arthroplasty earlier in the disease process than has been previously documented. Additional research is needed to confirm these findings and to understand the reasons for the variation in the extent of arthritis prior to knee arthroplasty.

KL grades for 96 patients who had knee arthroplasty within 1 year of radiograph

KL Grade	Frequency	Percent	Cumulative Percent
0	1	1.0	1.0
1	8	8.3	9.4
2	9	9.4	18.8
3	36	37.5	56.3
4	42	43.8	100

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SHORT TERM CHANGES IN BONE MARROW LESION (BML) VOLUME IN KNEE OSTEOARTHRITIS

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Background: Bone marrow lesions (BMLs) show evidence histologically of bone damage or microfracture, and are related to malalignment, to pain and to OA progression. BMLs have been shown in observational studies to change in volume within 1 year follow-up. More recently we have shown changes in knee OA detectable within 6 weeks. The aim of this analysis was to determine whether changes in BML volume can be detected within an even shorter time interval and whether a treatment effect signal could be observed with small numbers of subjects.
Methods: Men and women aged 40 years and older with painful knee OA and who met ACR criteria for the disease were recruited for participation in an ongoing open label clinical trial of intra-articular steroid therapy. Subjects who took part in the study had significant knee pain and grade 2 or higher knee OA. They had a baseline magnetic resonance image (MRI) prior to having a steroid

injection and a repeat MRI scan at follow up within a 2 week period. To assess BML volume, axial PDW FS (TR 1500ms, TE 15ms, FoV 14cm, 256×256) and sagittal (3D WATSc: TR 20ms TE 7.7ms, FoV 15cm, 288×288) scans were obtained. Using the axial scan, manual segmentation of BML volumes in the whole knee was performed by a single observer using a strategy outlined (OARSI 2010) by MacLure et al. Test-retest repeatability was assessed by one observer separately segmenting 24 MRI images from 6 knees. Using the standard deviation of the difference between repeated measurements to calculate Bland Altman limits of agreement as an indicator of measurement error, we determined how much BML volume change represented a change greater than expected based on measurement error. Test-retest reliability was good (ICC = 0.89; 95% CI 0.80 to 0.97). The Bland-Altman 95% limits of agreement for rating differences, assuming a zero-difference mean (no change in BML volume) were -870mm^3 to +870mm^3.

Results: 26 subjects who took part in the study were included in this analysis. Their mean age was 63.5 (SD 9.4) years and 13 were female (50.0%). The average time between baseline and follow up scan was 10.4 days (SD 3.2 days, range 5 to 16 days). 14 subjects had BMLs at the baseline visit, and were the focus of our analysis (median volume = 1,095mm^3; IQR 225mm^3 to 3,611mm^3). At follow up, the median volume was 1,394mm^3 (IQR 187mm^3 to 2,219mm^3). The median change in BML volume for these 14 individuals was -119mm^3 (95% CI for median change -540mm^3 to +470mm^3). Five (35.7%) subjects had a change in BML volume greater than that which would be expected based on the observed measurement error; two with higher, and three with lower volume than at baseline. Nine of the 14 participants with BMLs at baseline had changes in BMLs at follow up greater than 50%; Of these, four participants had an increase of greater than 50%, and five a decrease of greater than 50%. The 12 participants with no BMLs at baseline had no BMLs at their follow up visit.

Conclusion: In this small sample of subjects with knee OA approximately one third of those with BMLs showed evidence of BML volume change within 16 days. Although we studied only a limited number of subjects, MRIs were obtained before and after steroid injections and we could not detect a clearcut treatment signal.

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A RAPID, NOVEL METHOD OF VOLUMETRIC ASSESSMENT OF MRI-DETECTED SUBCHONDRAL BONE MARROW LESIONS IN KNEE OSTEOARTHRITIS IS COMPARABLE TO WORMS: PRELIMINARY VALIDATION

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Purpose: Subchondral bone marrow lesions (BML) are a potentially important imaging biomarker for knee osteoarthritis (OA). Imaging methods that rapidly, economically and accurately detect and measure BML are important in large OA trials and observational studies. Current manual semi-quantitative methods are time-consuming and based on an ordinal scoring system. We present a semi-automated method to measure BML volume quantitatively based on a gray-scale thresholding algorithm. We compare this method with BML assessment from the Whole-Organ Magnetic Resonance Imaging Score (WORMS).

Methods: Twenty subjects from the baseline data of the OAI Progression Cohort (Image Releases 0.B.1, 1.B.1) were randomly selected from the 115 whose knees had been WORMS-scored by OAI central imaging. Inclusion criteria was a baseline KL grade of 3. One subject was excluded due to susceptibility artifacts that obscured the distal femur. Sagittal turbo spin echo fat saturated (TSE FS) (0.357 x 0.357 x 3.0 mm, TR 3200ms, TE 30ms) intermediate-weighted MRI were obtained on a 3-T Siemens Trio MR system. A reader (CR) used semi-automated software to segment the subchondral BMLs in the distal femur. The software applies a grayscale thresholding algorithm to the raw image (Figure 1a-c) and provides the reader with regions for potential segmentation. Reader judgment is used to select, usually with 1 or 2 mouse clicks, the clinically appropriate region(s) of BML adjacent to subchondral bone and to reject irrelevant areas.

Analysis. The primary outcome was total segmented volume of BMLs in the femoral medial and lateral compartments, based on number of voxels highlighted. Comparison of lateral femoral BML volume was made with public-release WORMS scoring for the lateral femoral sub-regions (anterior, central, posterior). WORMS reports BML in 4 categories based on size of BML relative to the total sub-region (0-no BML, 1-<25%, 2-25-50%, 3->50%). An identical procedure was carried out in the medial femoral compartment. Raw data are presented in scatter plots showing measured volumes in each WORMS category. Spearman's correlation and the Kruskall-Wallis test were used to assess association between the two methods.

Results: A scatter plot showing BML volumes in the lateral femoral compartment against WORMS categories is shown in Figure 2.

The software method required an average of < 4 minutes per knee. The mean (SD) of BML volume was 429.7 mm^3 (593.4) and 132.1 mm^3 (224.3) for lateral and medial compartment respectively. Significant positive associations between the new volumetric measure and WORMS score were found in the lateral anterior, medial posterior, and medial central compartments. The correlation between volume and WORMS score by femoral compartment was 0.91 (p<.001) in the lateral anterior, 0.54 (p=0.01) in the medial posterior, and 0.57 (p=0.01) in the medial central. The lateral posterior and lateral central compartments had few BMLs (WORMS 1, 2, and 3 each had only one subject), limiting ability to assess association.

Conclusions: We have documented a fast, semi-automated software method to segment BML in knee OA subjects using TSE FS MRI that could potentially be a surrogate for WORMS scoring. This technique has the potential to provide a quantitative measure of BML rapidly and accurately - making it feasible to assess a large number of knees in a short period of time (days). This could substantially reduce study costs for large trials and cohorts such as the OAI. Further work on rater reliability, and using a larger sample and longitudinal data is under way.